# NEUROFIBROMATOSIS

## ORGANIZATIONAL GUIDELINES

Organizational Guidelines represent the minimum requirements for providing care for individuals with neurofibromatosis. Care and treatment should be provided in a manner that includes adherence to and consistency with each of the following Guidelines.

### CRS Enrollment:

Neurofibromatosis patients must be enrolled in an NF Clinic. The patient may be seen at other clinics as appropriate as determined by the Interdisciplinary Team. All treatment must be consistent with the goals set in the Neurofibromatosis Clinic and records from other clinics must be sent to the NF Clinic Site.

### Interdisciplinary Team Membership:

The following Team Members must be present during regional clinics and team conferences to review the patient information and determine the need to see the patient at a clinic site and must be available for inpatient consultation or coordination of care with inpatient staff:

- Pediatrician/PNP
- Geneticist/Genetic Counselor
- RN Nurse Coordinator
- Child Psychologist
- Pediatric Neurologist
- Social Worker
- Child Psychiatrist
- CRS Member / Caregiver
- Primary Care Physician[1]
- Vocational Rehabilitation for teenagers[2]

### Available Personnel:

The following personnel must be available to the member/adult at the neurofibromatosis clinic:

- Advocate
- Audiologist

[1] The Primary Care Physician will be invited to all Team meetings; however, it is understood that PCP will not always be able to attend.
[2] Vocational Rehabilitation Services representatives are to be invited to the Clinic.

- Child Life Specialist
- Translator

**Consultative Personnel:**

The Regional Clinic must have access for consultation to specialists including, but not limited to the following:

- Cardiologist
- Neurosurgeon
- Nephrologist
- Occupational Therapist
- Oncologist
- Otolaryngologist
- Ophthalmologist
- Orthopedist
- Pediatric Surgeon
- Physical Therapist
- Plastic Surgeon
- Speech Therapist

**Outreach Clinics:**

Outreach clinics are designed to provide a limited specific set of services including evaluation, monitoring and treatment in settings closer to the family than a regional clinic. Major treatment plan changes must be communicated to the regional clinic.

Members with neurofibromatosis may attend neurology, genetics, or orthopedic outreach clinics as determined by the Interdisciplinary Team.

**Facilities & Services:**

1. Age-appropriate setting for all patients
2. Defined age-appropriate services (i.e., Pediatrics, Adolescent Medicine and/or Internal Medicine)
3. Pediatric and Adult Intensive Care Units
4. Social Work Department
5. Identified clinic area for NF outpatient services
6. Access to the pharmacy

**Team/Staff Meetings:**

Team and staff meetings will be held based on the age of the patient and their diagnosis. At a minimum the following will occur:

1. Interdisciplinary Team Meetings / review and planning meetings (patient specific meetings) are to be held at least once every two years for planning and review.
2. Staff meetings annually to focus on issues of clinic patient care and clinic administration.
3. Education meetings annually to focus on new information regarding the care and treatment for persons with neurofibromatosis. These may be off site meetings.

**Lead Physician Specialists:**

Qualifications: The lead physician for patients with neurofibromatosis should be a geneticist, pediatrician or a Pediatric Neurologist with knowledge and experience in the evaluation, care and treatment of patients with neurofibromatosis.

**GUIDELINES FOR PATIENT SERVICES, EVALUATION & MONITORING FOR NEUROFIBROMATOSIS**

The purpose of these guidelines is to promote a uniform level of care at CRS Clinics for members and adults with neurofibromatosis, and to provide a general framework for good patient care. Their relevance to specific situations will depend on individual variations in clinical course and professional judgment. In addition, this document should serve as a tool to assess programs, secure resources needed to enhance patient care and education, and guide the future growth and develop treatment of neurofibromatosis.

**Diagnosis**

**Goal:** To provide accurate and timely diagnosis of neurofibromatosis.

**Diagnostic Criteria NF1:** As developed by the NIH Consensus Development Conference and subsequent changes, specified that 2 or more of the following be present: [1, 3]

1. 6 or more cafe-au-lait macules more than 5 mm in greatest diameter in prepubertal individuals and more than 15 mm in greatest diameter after puberty
2. 2 or more neurofibromas of any type or 1 plexiform neurofibroma
3. freckling in the axillary or inguinal regions (Crowe sign)
4. an optic pathway tumor

5. 2 or more Lisch nodules (iris hamartomas)
6. a distinctive, osseous lesion, such as sphenoid wing dysplasia or thinning of the cortex of the long bones (with or without pseudarthrosis)
7. a first-degree relative (parent, sibling, or offspring) with NF1 that met criteria 1-6 above

The diagnosis of NF1 cannot be made on the presence of cafe-au-lait spots alone; however, the family should be told that NF1 is by far the most likely diagnosis, since familial cafe-au-lait spots are an exceedingly rare condition. Additional criteria are almost always met by the age of 10 years. [3]

Confirmation of the diagnosis for NF 1 must be established prior to entry into the CRS program. Follow up within CRS requires the following activities:

- History

  Focus on symptoms associated with NF1, such as cognitive or psychomotor deficits, pain, visual complaints, progressive neurologic deficits, changes in bowel and bladder function, weakness, seizures, headaches, and childhood development history. [1]

- Family History

  Should include grandparents, great aunts and uncles and their descendants. When possible, an effort should be made to locate medical records of affected 1st and 2nd degree relatives. [1] Parents and siblings should be referred (this is not a covered CRS service) for examination for signs and symptoms of NF1. [3]

- Physical Examination

  Should give particular attention to possible manifestations of the disorder such as hypertension, scoliosis and other skeletal anomalies, Macrocephaly, focal neurological deficits (impaired vision, ptosis, optic atrophy), developmental disabilities, proptosis, Lisch nodules, short stature, signs of precocious puberty or hypogonadism, cafe-au-lait macules, and neurofibromas. [1]

- Tests

  Should be dictated by findings on clinical evaluation. Laboratory tests in asymptomatic patients are unlikely to be of value, particularly computerized tomography (CT), magnetic resonance imaging (MRI), electroencephalography (EEG), and evoked potentials. As an option, DNA testing may be provided at the Discretion of the NF Team.

- Counseling

  Must be provided for all patients and their families and should include: [1]
  1. Prognosis
  2. Genetics
  3. Psychological and Social Adjustment
  4. Family members
  5. Follow-up

6. Resources

Modified counseling is indicated for preadolescents who are likely to have NF1. [3]

- Written Report

  Should summarize clinical findings, test results, and information conveyed through counseling.[1]

**Diagnostic Criteria for NF2 per the Manchester Conference:** Individuals with the following clinical features have confirmed (definite) NF2:[3]

- Bilateral vestibular schwannomas (VS) OR
- First-degree relative with NF2 AND EITHER
- Unilateral VS < 30 y OR
- 2 of the following:
  - Meningioma
  - Glioma
  - Schwannoma
  - Juvenile posterior subcapsular lenticular opacity
  - Individuals with the following clinical features should be evaluated for NF2:
  - Unilateral vestibular schwannomas < 30 y AND
  - At least one of the following:
    - meningioma
    - glioma
    - schwannoma
    - juvenile posterior subcapsular lenticular opacities/juvenile cortical cataract
    - Multiple meningiomas (2 or more) AND
    - Unilateral vestibular schwannomas <30y OR
    - One of the following:
      - glioma
      - schwannoma
      - juvenile posterior subcapsular lenticuolar opacities / juvenile cortical cataract

**Diagnostic Activities for NF2[1] (unless otherwise indicated):** Evaluation for NF2 should never represent a single point in time but should include long term follow up.[3] Screening can be relaxed if there are no further tumors developing during a 5 to 10 year period or if NF2 molecular testing becomes more reliable for exclusion.[3] MR should be performed to rule out bilateral vestibular schwannomas definitely.[3] Persons with retinal hamartomas or cortical wedge opacities should be evaluated by a trained neuro-ophthalmologist.[3]

- History

  Focus on symptoms possible associated with hearing loss, tinnitus, dizziness, loss of balance, pain, headache and seizures

- Family History

  Include grandparents, great aunts and uncles and their descendants

  Should locate medical records for affected 1st and 2nd degree relatives

- Physical Examination

  Should give particular attention to possible manifestations such as cafe-au-lait macules and neurofibromas

  Neurological assessment should emphasize cranial nerves, balance and coordination

- Tests
  - ✓ Must include audiogram and brain stem auditory evoked responses (BAER)
  - ✓ High Resolution MRI with gadolinium should be used in patients with evidence of hearing impairments or abnormal BAER
  - ✓ Tests of vestibular function may be useful adjuncts to BAER
  - ✓ If no MRI has been performed by puberty, it should be obtained
  - ✓ Other tests as indicated

- Counseling

  Must be provided for all patients and their families and should include:

  1. Prognosis
  2. Genetics
  3. Psychological and Social Adjustment
  4. Family members
  5. Follow-up
  6. Resources

- Written Report
  Should summarize clinical findings, test results and information conveyed through counseling

  Goal: To provide accurate assessment of physical, emotional, and behavioral issues and educational / vocational needs, and to begin patient and family education.

## Education of Parents & Diagnosed Patients

### NF 1:

Families and patients may require support in the following areas (but not limited to these areas). Services should be provided if they are included in the CRS policy regarding covered services.

1. Adjustment to the diagnosis
2. Coping with medical sequelae and medical procedures
3. Attention problems or ADHD (CRS will refer patients requiring Medication Management to Behavioral Health Systems)
4. Educational difficulties including learning disabilities fine motor deficits.
5. Increased risk for psychological disorders / adjustment problems such as depression, low self-esteem, etc.
6. Linkage to community services such as DDD, Behavioral Health, AzEIP, ALTCS, SSI, housing, food, transportation.

## Ongoing Patient Evaluation and Monitoring

Goal: To anticipate and treat physical and psychosocial problems and complications of the disease.

### NF1 Follow-up Examination Guidelines:

Should be performed annually for NF 1 patients and counseling should parallel assessment described above[1]

1. Infancy[3]

Presence of tibial bowing should prompt referral to orthopedic surgeon familiar with management of NF1 related orthopedic problems in members

Prevention of fracture is of paramount importance in individuals with tibial bowing.

2. Childhood[3]

Annual vision evaluation by an experienced ophthalmologist during first decade of life.

Cranial MR imaging should be used when there is any evidence of optic nerve dysfunction. There should be special attention to the orbits and appropriate management determined by a multidisciplinary clinical team.

The role of surgery in the management of optic pathway tumors is limited and treatment usually involves chemotherapy and, less commonly, radiation therapy.

All members should be evaluated for psychosocial issues with an emphasis on those members suspected of having learning disabilities. Some members manifest attention deficit disorder and may benefit from treatment with stimulant

medication. Medication Management of ADHD will be referred to the Behavioral Health System.

Monitor for blood pressure evaluations associated with renal artery stenosis or, rarely, pheochromocytomas.

Decisions about surgical treatment and frequency of follow up on plexiform neurofibromas must be made judiciously and individualized for each patient. The Interdisciplinary Team should be consulted.

Members with headache or abdominal pain should have a careful physical and neurologic examination to exclude other underlying causes.

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3. Lifelong[3]

(CRS Members to age 21)

Specific lesions which are symptomic/function limiting may be removed as they occur by experienced surgeons. The long term benefit of removal of large numbers of neurofibromatomas by surgical excision or carbon dioxide laser is untested.

Persons with persistent hypertension or classical signs of pheochromocytoma should be evaluated further

Rapid growth of a plexiform neurofibromas or the development of de novo pain should prompt an immediate evaluation for bleeding or malignant transformation

**NF 2 Follow Up Examination Guidelines:**

1. The criterion Guideline for the identification of vestibular schwannomas is MR imaging of the head with 3-mm cuts through the internal auditory canals with and without gadolinium enhancement.
2. All patients with a new diagnosis of NF2 should undergo full spinal MR imaging with or without gadolinium enhancements to aid in prognostication.
3. Patients with intramedullary tumors should receive an annual follow up MR image.
4. If tumors are found, follow up MR imaging should be performed every 6 to 12 months.
5. Part of the evaluation of a person suspected to having NF2 should include review of pathology reports and review of original tumor sections when possible.
6. In families with early onset NF2, the screening protocol should begin in early childhood.
7. Individuals with NF2 should have an annual neurologic evaluation with cranial MRI as well as audiometry and brainstem auditory evoked responses for those with functional hearing.

8. Follow up ophthalmologic evaluations and spinal imaging are recommended for persons with problems in these areas.
9. Surgical treatment should be limited to specialty tertiary care centers with experienced otolaryngologists and neurosurgeons
10. The Interdisciplinary Team should work together to coordinate care and follow up
11. Surgical planning should be done by Neurosurgeon and/or Otolaryngologist. Referral by NF team can be based on MRI changes or clinical symptoms.
12. Radiation therapy should be considered carefully
13. Treatment of vestibular tumors should include counseling of the problems with balance. Drowning and near drowning caused by underwater disorientation is especially important
14. Hearing and speech augmentation is an important part of management of NF2. Lip reading and hearing aids may be useful
15. Review social adjustment development and appropriateness of school / vocational placement.

## Treatment

Goal: To anticipate and treat progression and complications of the disease.

**Management Options for NF 1 patients**:

Management Options for Optic Glioma:

- Annual ophthalmologic examination using MR and CT imaging to document size, shape and extension
- Appropriate consultation will be made if special circumstances such as disfiguring orbital mass or large tumors compressing adjacent structures

Management Options for Other Neural Tumors:

- Manage these tumors in same manner as in general population

Management Options for Orthopedic Problems:

- Kyphoscoliosis and tibial bowing benefit from early intervention and should be managed by an orthopedist familiar with complications

Management Options for Vascular Problems:

- Thorough evaluation of hypertension
- Other vascular disorders must be handled on an individual basis in the same manner as they would be in the general population

## Psychosocial Issues

Goal: To anticipate and treat social and emotional problems of patients and their families.

Patients and families should have available interdisciplinary multi specialty care as well as follow up services including community support research and referral services, education advocacy and placement assistance, -psychological and neuropsychological evaluations, and developmentally appropriate support and education to the member. This would include the services of a social worker, Member Psychologist, child life specialist and special educator.

1. Patient advocacy through education of personnel in schools, insurers, health care services, regional and national health organizations and welfare services.
2. In-service education of health professionals and health sciences students, social sciences students and others.
3. Assist in linking adults to Vocational Rehabilitation and Vocational education and training.

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Neurofibromatosis; National Institutes of Health Consensus Development conference Statement; Vol 6; No 12; July 13-15, 1987.
Committee on Genetics, ñHealth Supervision for Children with Neurofibromatosisò, Pediatrics; Vol. 96, No. 2; August 1995.
David H. Gutmann, Arthur Alysworth, John C. Carey, Bruce Korf, Joan Marks, Reed E. Pyeritz, Allan Rubenstein, David Viskochil; ñThe Diagnostic Evaluation and Multidisciplinary Management of Neurofibromatosis 1 and Neurofibromatosis 2; JAMA; July 2, 1997.